which, from not being of sufficient solidity to bear the weight of the superincumbent pressure, yields to the impressed force, and, therefore, causes the arches to crack and give way. After the superfluous material is axed off, the brick is then rubbed on the rubbing-stone, and great nicety is required to be observed in this particular, so as to bring the upper edges of the brick, both at the back and front faces as well as at the end, to the exact gauge, as then the joints will not only be of equal thickness throughout the arch, but the whole of the bricks when set will be better calculated to sustain and distribute equally among them the pressure under which they are liable to be subjected.

The soffit brick, then, being finished, the next step is to prepare the upper brick. The end which is to be placed next the soffit-brick is to be cut and rubbed square from the face, and made to suit the bevil of that course; it is then placed against the end of the soffit-brick, and marked both on the back and front face with the taperiog-mould, its length being taken from the mark which corresponds to the length of that course. The bevil is then to be placed against the top edge of the brick to the mark, and its length marked across to the bevil with the tin saw, the ends being marked square across also. The angles which the end makes before the brick is tapered are equal to those of the other end, and although there will arise some little irregularity in the tops of the upper bricks of the arch, arising from the difference of curvature between the extrados and intrados, still it will be found to be so very slight, as not worth noticing in actual practice. The superfluous material of the brick in question is then to be axed off, and the brick, as cut, must then be rubbed carefully on the stone so as to correspond with the taper of the soffit-brick and the mould. The same operations are then to be gone through with the remaining courses.

We have received the following note, which will sufficiently explain itself:—

"Sir,—Will you be so kind as to inform a bricklayer the proper method to strike out an arch, of which the enclosed is a sketch as near as I can make it, so that it can be executed in brickwork, and set in putty. The opening is 3 feet 6 inches, the rise 4 inches, the face 9 inches, and soffit 4½ inches, and you will oblige your humble servant, H. J."

We have somewhat altered the original rough sketch, as sent us, in order to make the arch more suitable for execution. All the courses of bricks of an arch of this description are to be struck out upon precisely the same principles as are those of the foregoing camber arch. The courses, as arranged in the annexed arch (fig. 3), were traced and marked from a small paste-board mould by following the soffit curve. An approximation to the proper taper for the mould was obtained by finding the lengths of the extradosal and intradosal lines; then, as the length of the extrados : the length of the intrados :: the thickness of a brick at the top : the thickness next the soffit. From what has been said in reference to the execution of a camber arch it is supposed that no difficulty will arise in striking out and executing an arch similar to this. The centres and dimensions are sufficiently definite and need no description.

The courses of bricks of both two and four centred arches are usually arranged upon the same principles as the camber arch; a taper is generally assumed for the mould, which is placed in the situation of the key-course, and traversed downwards until it coincides with the springing lines. And sometimes the courses of bricks of elliptical arches are formed by the same method; but we intend by-and-by as our time will permit, to give a general description of forming and executing gothic, elliptical, semi-circular, segment, and other arches, as well as niches.

With reference to the manner of *setting* ganged work generally, we must also leave that until another occasion.

JOHN PHILLIPS.

SMOKE PROHIBITION BILL.—Last week, on Mr. Mackinnon moving that the House of Commons resolve itself into a committee to further this measure, it was observed that only 29 members were present, when an adjournment immediately took place!

INSTITUTION OF CIVIL ENGINEERS.

At a meeting held 10th June, 1845, Sir John Rennie, President, in the chair, the paper read was by Mr. James Stirling, and described an ingenious air-engine, invented by his brother and himself. The movements of this machine are founded upon the well-known pneumatic principle, that air has its bulk or pressure increased and diminished in proportion as its temperature is raised or lowered. The application of this principle was exemplified by drawings, and a model, exhibiting a machine composed of two strong or light air vessels connected with the opposite ends of a vertical cylinder, in which a piston works in the usual manner. Within these air vessels are suspended two air-tight vessels or plungers, filled with non-conducting substances, and attached to the opposite extremities of a beam capable of moving up and down alternately, to the extent of one-fifth of the depth of the air-vessels. By this motion of the plungers the air, which is in a heated state below, is moved to the upper part of the vessels, and in its transit traverses a series of vertical capillary passages between thin metallic plates, which absorb the greater part of the caloric; the remainder is taken up by a refrigerator of tubes filled with water; the air at the heated end is at about 700°, and has a proportionate pressure. When it arrives at the cooled end, it is reduced to about 150°, and the pressure diminished to a corresponding extent. Therefore, as the interior vessels move in opposite directions, it necessarily follows that the pressure of the condensed air in one vessel is increased while that of the other is diminished. A difference of pressure is thus produced upon the opposite ends of the piston, and a reciprocating motion results, which is communicated through a beam, connecting rod, crank, and fly-wheel to the machinery when driven. Machines upon this principle were stated to have been worked for some years past at Dundee, with considerable saving of fuel, as compared to a steam-engine of similar power, and doing the same work. It is now proposed to adopt it to marine purposes, to which, from its simplicity and slight expenditure of fuel, it appears well fitted. The theory of the expansion of air, and its practical adaptation as a moving power were very fully discussed, as were the mechanical difficulties which appeared to have been very ingeniously overcome by Mr. Stirling, who attended the meeting, and explained his invention. The engine appeared to receive the approval of the members who were evidently not prepared to find so perfect a machine, and one so practically useful.

On the 18th instant a paper was read by Mr. G. Edwards. It described the method employed for breaking up the shoals in the river Severn, between Stourport and Gloucester. These shoals consist of marl rock, so compact and tough, as to resist all attempts to break it up with the steam-dredger, or by prize-bars, or with a powerful species of subsoil plough. Recourse was therefore had to blasting with gunpowder, and the process of these operations formed the subject of the paper. It appeared that during the summer months there was in some places only 2 feet depth of water over some of the shoals; and the navigation was therefore greatly impeded.

In 1842 an Act was obtained for the improvement of the Severn; and under the directions of Mr. W. Cubitt the various works were commenced. The object was, to obtain a channel with a depth of at least 6 feet of water at all times throughout the river. Messrs. Grissell and Peto were the contractors for the work, and for them Mr. Edwards designed and executed the blasting operations. A series of rafts were moored in a line over the shoal parallel with the bank of the river. Along the centre of each raft, there was an opening through which wrought-iron tubes 3½ inches diameter, were driven down at intervals of 6 feet apart through the gravel down to the marl; withinside these tubes the workmen used the chisel-pointed jumperbars to make the short holes to a depth of 6 feet below the surface. The loose stuff was extracted by an auger-tool, a cartridge of canvas, well pitched and tallowed, containing 3 lbs of powder, was lowered through the tube into the hole, which was well rammed with loose marl. The charge was then fired by means of Beckford's fuse. There was generally but little apparent external effect from the shot, except lifting the pipe a few inches, but sometimes a column of water would be driven up through the pipe to the height of 40 or 50 feet. It was found that each shot loosened a mass of marl of conical or parabolic form, of which the borehole was the centre and its bottom the apex, so that four adjoining shots of two parallel lines would leave between them a pyramidal piece of marl, which was removed by the dredging machine with the loose stuff. This operation of blasting was repeated in parallel lines down all the shoals, and the stuff was dredged up at the rate of 200 to 300 tons per day. The cost of the blasting was about 9s. 9d. per cube yard. It was stated that the six principal shoals had all been successfully operated upon, and great credit had been given not only to the design but also to Mr. Edwards for the systematic and complete manner in which he had arranged and conducted the operations.

An excellent working-model was exhibited, by Mr. Slyde, of the steam-excavator. Several alterations appeared to have been made in its form and the mechanical parts of its combination, adapting it for dredging under water. It was much improved, and seemed now likely to become a useful instrument in engineering operations.

SUSPENSION BRIDGES.

SIR,—I have but this moment seen THE BUILDER of the 31st, and should have been astonished at the attack upon my plan of bridges if I had not known the source of your information. The first part is from a letter by "An Old File," which appeared in the *Mechanics' Magazine*; this is a direct falsehood, and for proof that it is so I refer you, and such of your readers as may be interested in the subject, to the number of that excellent periodical that was published on the 31st. The second part I think is from the *Mining Journal*, which is also equally false, and is refuted by calculations in the last number of that periodical. But lest this may not be the particulars to which you allude, I will give you a list of the bridges that have been and are erecting on my plan, which vary from the small ones in the park to bridges for the heaviest traffic of 250 feet span. They are—the Victoria Bridge, Bath; five Government bridges, in the Regent's Park, London; five for the Indian Government; one across the Leveu, in Scotland, for Sir James Colquohoun; two for the Earl of Caledon, in Ireland; one across the Bann, at Banbridge, in Ireland; one for G. S. Harcourt, Esq., at Wraysbury, near Windsor; one for H. Miller, Esq., at Frome; one for the river Lea trustees, at Bow, Middlesex; a county bridge in the parish of Hexton, Wilts; and a private bridge for Col. Wroughton Stowal, Wilts. Besides these I have upwards of 30 copies of plans, &c., in my office at the present time for bridges in contemplation, or about to be erected, in various parts of the world, with which I am connected. I also refer to all I have written upon the subject, and shall be happy to hear and to consider any objections that may be raised against either of the bridges that I have erected, or any that are in contemplation, or against anything I have written upon the subject; but I must beg the favour of argument being used rather than assertions.

I do not wish to criticise any other part of your remarks, for this is all that concerns me, yet still I will hazard a few observations on them. I must object to your position, that calculations are not always to be relied on, it is the abuse and not the use of them that mislead men. The accident at Yarmouth would not have happened if the engineer had calculated the forces of that bridge, for I find from the data given it was capable of resisting a weight on the platform of only 40 lbs. per square foot with safety, whilst at any time it was liable to a load of 70 lbs. There is another point in which I differ from you, though I grant percussion, &c. may alter the internal structure of iron and weaken it, yet in a bridge which is perfectly quiescent, nothing but being strained beyond the limits of elasticity can effect the strength of the structure, the determination of which is a matter of *calculation*,

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